CLASSIFICATION SECRET SECRET

CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT

CD NO.

50X1-HUM

COUNTRY	USSR	DATE OF INFORMATION	1948
SUBJECT	Scientific - Geophysics, meteorology		
HOW PUBLISHED	Bimonthly periodical	DATE DIST.	4 Jan 1951
WHERE PUBLISHED	Leningrad	NO. OF PAGES	5
DATE PUBLISHED	Sep 1948	SUPPLEMENT TO REPORT NO.	
LANGUAGE	Russian		

THIS IS UNEVALUATED INFORMATION

SOURCE Meteorologiya i Gidrologiya, No 5, 1948, pp 34-39.

HIGH ALTITUDE DEFORMATION FIELDS OF THE NATURAL SYNOPTIC PERIOD

S. T. Pagava

The natural synoptic period is one of the most important discoveries of B. P. Mul'tanovskiy, who was several years ahead of foreign scientists in dealing with this problem. Starting in 1922 on the basis of his discovery, Mul'tanovskiy drew up forecasts for 6-7 days in advance. Since the end of 1944, forecasts of the development of synoptic processes and weather for the current and following periods (up to 18 days) have been produced in the Central Forecasting Institute.

The natural synoptic period is a time interval in which the main temperature-pressure fields in the troposphere are maintained, thus providing a definite orientation of pressure formations at the earth's surface and conservation of geographical distribution of pressure centers in the surface air layer throughout the natural synoptic region. In other words, the main heat and cold centers in the troposphere and the main high-altitude pressure formations which are components of deformation fields maintain a definite geographical position during the period. Another synoptic period begins with the formation of a new high-altitude deformation field, which provides a different orientation of pressure formations at the earth's surface.

The importance of high-altitude deformation fields for establishing the boundaries of the period is readily apparent from the definition. Therefore, we must find which high-altitude pressure formations are components of the deformation field. Study has shown that those high-altitude cyclones and anticyclones which correspond to independent thermal centers in the troposphere are components of the deformation field. If a high-altitude cyclone does not correspond to a cold center in the troposphere and a high-altitude anticyclone to a warm center, these pressure formations cannot be components of the deformation field determining the synoptic period. A high-altitude deformation field whose components correspond to independent thermal centers in the troposphere is called a deformation field of the natural synoptic period.

SECRET

CLASSIFICATION SECRET

STATE	X	NAVY	X	NSRB		DISTRIBUTION					
ARMY	X	AIR	X	FBI							

A sufficiently developed high-altitude cyclone always corresponds to an independent cold center in the troposphere, and a sufficiently developed high-altitude anticyclone, to a warm center. However, frequently there are high-altitude cyclones and anticyclones which are insufficiently developed. For example, there may be an independent cyclone in the trough of a high-altitude cyclone which is peculiar with respect to the latter. Can this cyclone be considered a component of the high-altitude deformation field of the natural synoptic period? It follows from the definition that this peculiar high-altitude cyclone should be considered a component of the deformation field if it corresponds to an independent cold center in the troposphere. Similarly, if an independent anticyclone nucleus in the wedge of a high-altitude anticyclone corresponds to an independent heat center in the troposphere, it should be considered a component of the deformation field of the natural synoptic period.

The high-altitude deformation field of the natural synoptic period must be determined accurately to draw up the forecast, as well as to determine the boundaries of the period. Prognosis of the development of synoptic processes and weather for two contiguous periods is based upon analysis contour and isallohyps /isallobaric gradient?/ maps of the tendency. The contour map of the tendency is the mean map of baric topography for the first 2 days of the period. It is constructed for the 500-mb surface in the following way: data on the contour map of the tendency of the past period is substracted from data on the contour map of the present period and these differences are entered on a blank; analysis of this produces the isallohyps map of the tendency of the current period. As a rule, the most valuable conclusions in practice are obtained when a definite conclusion can be made as to the type of shifting of the deformation field as a whole. The isallohyps of the tendency of the period are a function of temperature and pressure.

The isallohyps map of the tendency shows the regions in which the height of isobaric surfaces has varied in comparison with the tendency of the past period. The geographical distribution of isallohyps of the period is basically conservative throughout the period. The latter is proven by the fact that the qualitative correlation coefficient between the distribution of sign of the isallohyps of the tendency of the period and the isallohyps of the corresponding period is 0.77. This is further confirmed by the fact that isallohyps maps of each day of the period are similar to each other as well as to the isallohyps maps of the tendency of the period. The isallohyps map for a given day of the natural synoptic period is constructed in the following way: data on the contour map of the tendency of the past period is substracted from data on the baric topography map of the given day of the current period and these differences are entered on a blank; analysis of this produces the isallohyps map for the given day of the synoptic period.

The above is explained by the fact that directivity of the development of atmospheric processes is maintained during the natural synoptic period. Positive isallohyps of the tendency generally indicate predominance of advection of heat in the region during the natural synoptic period, while negative isallohyps indicate advection of cold. A region where positive isallohyps of the tendency coincide with convergence of the contours is anticyclogenetic while a region where negative isallohyps coincide with divergence of contours is cyclogenetic. Using these principles and patterns published in 1946 in "Basic Principles of the Synoptic Method of Long-Range Weather Forecasting" [redacted], the deformation field of the new synoptic period is defined. But definition of the type of synoptic processes for the new period by analysis of contour and isallohyps maps of the tendency of the current period requires that the frontal zones on the tendency map of the period be maintained throughout the entire period. 50X1-HUM

In the above work, it was established that the qualitative correlation coefficient between the distribution of the sign of the pressure field on mean 500-mb maps of the tendency of the natural synoptic periods and the corresponding periods is 0.83. This shows that frontal zones on the contour map of the tendency, while basically maintained, can undergo some changes during the period. Therefore, to determine the deformation field of the new synoptic period, it is first necessary to establish the fine changes which may occur during the current synoptic period.

The simplest case is when the centers of the positive isallohyps of the tendency of the period coincide with the center of high-altitude anticyclones on the contour map of the tendency of the period, the centers of the negative isallohyps coincide with the centers of high-altitude cyclones, and the peripheries of the centers of positive and negative isallohyps coincide, respectively, with the ridges and troughs of high-altitude pressure fields. In such cases, the frontal zones on the contour map of the tendency remain practically unchanged throughout the period and, therefore, the prognostic conclusions for the beginning of the following period are obtained by direct use of the abovementioned patterns.

There are cases, however, when there is no such complete correspondence between the distribution of contours and isallohyps of the tendency of the period. These cases indicate instability of the frontal zone during the period. In these cases, the problem of the relationship, with respect to intensity, of two factors, dynamic and advective, must be solved. If the dynamic factor is more intense than the advective, or vice versa, the frontal zone will change during the period, while if both factors are equal, no substantial change will occur.

To illustrate this principle, let us consider the following examples. Let us assume that on the contour map of the tendency in the region covered by a high-altitude anticyclone we have positive isallohyps whose centers coincide with convergence of contours, while the periphery of a center of positive contours lies in the region of divergence. In this case, the main heat advection is directed to the region of convergence of contours and therefore the heights of isobaric surfaces increase in the region during the period. The latter accuses weakened heat advection in the region of divergence of contours on the tendency map of the period, as a result of which the height of isobaric surfaces will decrease. This decrease in the height will weaken heat advection still further and intensify divergence in this region, which will lead, at the end of the period, to replacement of heat advection by advection of cold.

Thus, in the given case, the new period begins with destruction of the high-altitude anticylcone in the region of divergence of contours, despite the presence in this region of positive isallohyps on the tendency map, and with the formation of an anticyclone at the earth's surface in the region of convergence.

Let us assume that in a region covered by a high-altitude anticyclone, we have positive isallohyps with a center in the region of divergence of contours on the contour map of the tendency. In this case, there will be intensive heat advection in the region of divergence during the period, due to which divergence will be slightly weakened and the heights of isobaric surfaces will increase in this region.

If, on the contour map of the tendency of the period, the center of a high-altitude anticyclone coincides with a center of positive isallohyps, the heights of isobaric surfaces will remain practically unchanged throughout the period in the region of divergence of contours.

In the three cases considered, it is assumed that the heat center corresponding to a high-altitude anticyclone on the contour map of the tendency is not isolated on the map of relative topography of the tendency (the relative topography map of the tendency of the natural synoptic period is the mean relative topography map for the first 2 days of the period), but that conditions are present so that advection of heat is maintained throughout the period.

If the center of a high-altitude anticyclone coincides with a center of positive isallohyps and the heat center on the relative topography map of the tendency of the period corresponding to this anticyclone is isolated, then no substantial changes will take place during the period in the frontal zones connected with the high-altitude anticyclone. In this case, we have a quasi-stationary anticyclone.

In cases where there are negative isallohyps spreading to the region of convergence of contours in the region of a high-altitude cyclone on the tendency map of the period, analysis of current material to establish changes of frontal zones during the period is similar to analysis of the examples described above.

If, on the tendency map of the period, there are negative isallohyps of the tendency in the region of a high-altitude anticyclone and positive isallohyps in the region of a high-altitude cyclone, filling of the cyclone and destruction of the anticyclone will take place during the period. This must be taken into consideration in the analysis of the corresponding frontal zones to determine the deformation field of the new natural synoptic period.

There are also relatively rare cases in which some high-altitud pressure formations present in the beginning of the period subsequently change their geographical position substantially. The determination of such high-altitude pressure formations at the beginning of the period is of great importance both for forecasting the development of synoptic processes in the current period and for establishing the deformation field of a new natural synoptic period. Isallohyps maps of the first and second day of the natural synoptic period are used along with contour and isallohyps maps of the tendency of the period to clarify moving high-altitude pressure formations. If the contour and isallohyps maps of the second day are analogous both to the corresponding maps for the first day and to the tendency maps, the high-altitude pressure formations will move little during the period.

But let us suppose that there is a cyclone with sharply defined divergence of the contours on the contour map of the first day of the period and substantial center of negative isallohyps coinciding with regions of divergence of the contours of the above cyclone on the isallohyps map of the first day of the period. Further, let us suppose that the values of these isallohyps decrease substantially towards the center of the cyclone and eventually change to positive values. Then, suppose that on the contour map of the second day of the period, the cyclone center shifts toward the region of divergence of the contours on the map for the first day. The center of the negative isallohyps on the map for the second day of the period, without weakening in intensity, has shifted with respect to its position on the map for the first day and is now in the region of divergence of contours of the cyclone on the map for the second day of the period. This high-altitude cyclone will shift in the direction noted in the following days of the current period.

In the given case, the high-altitude cyclone will shift because of the considerable decrease in the heights of isobaric surfaces in the region of divergence of contours, whereas the heights will remain unchanged or increase in the region of its center.

There are also cases in which a high-altitude anticyclone changes its geographical position considerably during the period. These anticyclones are determined in the beginning of the period in the same way as the shifting high-altitude cyclone just discussed.

The cases cited of analysis of the tendency of the natural synoptic period to clarify the development of synoptic processes in the period do not of course include all cases encountered in operational work, but these are the most important from the prognostic standpoint.

The above makes it clear that the changes which will take place in the frontal zones during the current period must be established before patterns can be used to determine the deformation field of a new natural synoptic period.

Analysis of the tendency of the current natural synoptic period to establish the deformation field of the following period produces the most valuable practical conclusions when it is possible to examine the deformation field as a whole on the tendency map of the period. The deformation field of the tendency of the period is most stable when the heat and cold centers on the relative topography map of the tendency of the period coincide, respectively, with regions of anticyclones and cyclones which are components of the deformation field on the contour map of the tendency of the period while the centers of positive and negative isallohyps coincide respectively with centers of these cyclones and anticyclones on the isallohyps map of the tendency of the period. If a band of positive isallohyps passes in the region of a hyperbolic point of the deformation field, the new period will begin with cyclonic reorganization; if a band of negative isallohyps passes in this region, the new period will begin with anticyclonic reorganization. In the first case, the zones of convergence are active, but this process gradually leads to intensification of zones of divergence and cyclonic reorganization, with which the new natural synoptic period begins; the reverse development of processes holds in the second case.

There also might be a case in which a cyclone, or anticyclone, corresponds on the contour map of the tendency of the period to a center of negative, or positive, isallohyps on the isallohyps map of the tendency, but there is no corresponding cold, or heat, center on the relative topography map of the tendency of the period. The patterns previsouly discussed for construction of the deformation field cannot be used in these cases. Neither can these patterns be used when the cyclones and anticyclones making up the deformation field on the contour map of the tendency correspond to centers of cold and heat on the relative topography map of the period but not all components of the deformation field correspond to centers of isallohyps of the tendency.

We should also keep in mind that reorganization of processes does not always occur simultaneously in all levels of the troposphere. There are comparatively rare cases when the natural synoptic period, according to surface data, begins approximately 24 hours earlier than on the 500-mb surface, and vice versa.

This paper on the analysis of some cases of height deformation fields of the natural synoptic period is a supplement to the conclusions which were obtained in the work previously mentioned.

- E N D -